The Action of Genes Controlling Apical Dominance in *Pisum sativum* L.

by

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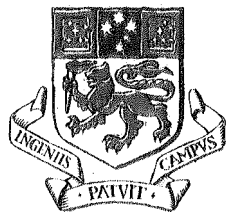
Submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy



UNIVERSITY OF TASMANIA

July, 1994

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Acknowledgments

I thank my supervisors Prof. I.C. Murfet and Dr. J.J. Ross whose advice and support were extremely valued; Prof. J.B. Reid for the provision of the IAA internal standard and for his helpful comments on the manuscript and work; Prof. D.S. Letham and Dr R.E. Summons for the provision of cytokinin standards; Prof. D.S. Letham and Dr C.H. Hocart for their advice on cytokinin analysis; Prof. M.G. Cline for valuable correspondence; Dr N.W. Davies for technical advice and assistance with the use of the mass spectrometer; P. Bobbie, H. Dungey, O. Hasan, K. McPherson, M.M. Nguyen and N. Lawrence for technical assistance; my colleagues, Dr O. Hasan, Dr S. Swain and Mr J. Weller for the pleasant banter; and my parents and other friends, particularly Amanda, for their continued support and encouragement.

ABSTRACT

Four non-allelic mutants with increased branching, *rms1*, *rms2*, *rms3* and *rms4*, were utilised to investigate the control of apical dominance in the garden pea, *Pisum sativum* L. The role of indole-3-acetic acid (IAA) was examined in detail by gas chromatography-mass spectrometry (GC-MS), quantification of free IAA in shoot tissue of various ages, and by the application of IAA and the auxin transport inhibitor 2,3,5-triiodobenzoic acid. The procedure for the purification and quantification of endogenous IAA was refined to allow rapid routine analysis of this substance. Wedge grafts of young seedlings were performed to determine the site of action of the four *ramosus* genes and to determine whether or not a graft-transmissible substance is involved in their action. The levels of cytokinins zeatin riboside and dihydrozeatin riboside were also quantified by GC-MS from the xylem sap of *rms2* and wild-type roots, after the development of a suitable extraction and quantification technique.

Branching was inhibited in *rms1* and *rms2* scions when grafted to wild-type stocks while *rms1* and *rms2* stocks were not able to promote branching in wild-type scions. The most plausible explanation of these results is that the *rms1* and *rms2* mutations act to promote branching by altering the level of a hormone-like substance which is produced in the rootstock and shoot. Further grafting studies indicated that the *Rms1* gene acts prior to the *Rms2* gene in the biosynthetic pathway for the same substance. It is unclear whether the *rms1* and *rms2* mutations act by increasing the level of a branching promoter, or by decreasing the level of a branching inhibitor, although the latter seems more likely.

Similar grafting studies indicated that the *rms3* mutation acts predominantly in the shoot but also in the rootstock and appears to alter the level of a graft-transmissible substance other than that controlled by the *Rms1* and *Rms2* genes. As above, the specific nature of the substance controlled by the *Rms3* gene has not been elucidated. In contrast, the *rms4* mutation does not appear to control the level of a graft-transmissible substance.

IAA quantifications from mutant and wild-type shoot tissue indicated that the increased branching in each of the mutant shoots was not attributable to a reduced level of endogenous IAA in comparison with the level in wild-type plants.

Mutant *rms4* plants contained normal levels of IAA in comparison with wild-type plants. Branching in *rms4* plants was not inhibited by IAA application. Furthermore, *rms4* rootstocks appeared over-responsive to the graft-transmissible substance produced by *rms2* scions since *rms4* rootstocks exhibited a promotion of lateral growth at the cotyledonary node when grafted to the *rms2* mutant scions compared with the *rms4* rootstocks grafted to *rms4* or wild-type scions. It is therefore suggested that the *Rms4* gene influences the response to factors involved in the control of branching.

The *rms1*, *rms2* and *rms3* plants contained an elevated level of IAA in comparison with wild-type plants, prior to, during, and after bud release. This accumulation of IAA in *rms1*, *rms2* and *rms3* plants was not simply due to imminent or actual lateral bud growth or release as firstly, it did not occur in comparable *rms4* plant portions, and secondly, was present in *rms2* scions in which branching was inhibited by grafting to wild-type rootstocks. Possible explanations for the accumulation of IAA in *rms1*, *rms2* and *rms3* plants are discussed in view of the conventional theory that IAA acts to inhibit lateral branching.

In the case of the *rms2* plants, the level of zeatin riboside and dihydrozeatin riboside in the xylem sap of the rootstock did not appear to be significantly different from that in wild-type plants. Since these cytokinins may be the most abundant and physiologically important cytokinins in the root xylem sap it appears unlikely that the graft-transmissible substance controlled by the *Rms2* gene in the rootstock is a cytokinin. The possibility that a novel substance may be involved in the control of branching in pea is suggested.

Studies on the effect of the flowering genes *Sn*, *Dne* and *Ppd* on branching in pea supported the proposition that these genes influence the pattern of branching along the stem.

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